

**GAMMA-RAY LARGE AREA  
SPACE TELESCOPE  
(GLAST)  
PROJECT**

**GROUND DATA SYSTEM  
MISSION ASSURANCE REQUIREMENTS**

**July 1, 2003**



**GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND**

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NASA Goddard Space Flight Center  
Greenbelt, Maryland

GLAST GROUND DATA SYSTEM MISSION ASSURANCE REQUIREMENTS

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## 1.0 GENERAL

This document, referred to as the "Ground Data System MAR," defines the Safety and Mission Assurance (S&MA) requirements for the GLAST Ground Data System (GDS). Additional mission assurance requirements are defined in the Statement of Work (SOW).

References to the "developer" in this document are directed to the developer of GLAST GDS components. References to the "SAM" refer to the NASA GSFC GLAST Project Systems Assurance Manager. References to the "Government" or the "GLAST Project Office" refer to the NASA GSFC GLAST Project Office.

The developer shall create a Performance Assurance Implementation Plan (PAIP) that provides a comprehensive plan for accomplishing the S&MA activities in compliance with the requirements herein. The PAIP shall describe the developer's system for planning, documentation, and controls that will ensure complete traceability through all phases of the design, implementation, test, and operation of deliverable items. The developer's PAIP shall be delivered or made available to the Government in accordance with **DID A**.

The PAIP shall include:

- a. An overview of the developer's plan for accomplishing the assurance activities required by the GDS MAR
- b. Specific and detailed description of how the performance assurance requirements are to be accomplished. Referenced documents that provide the required details shall be submitted with the PAIP.
- c. The rationale for any planned noncompliance to the GDS MAR including the details of the developer's alternate approach, if any, to meet the specific GDS MAR requirement

If the developer delivers other documentation that meets the requirements of the PAIP, then the PAIP will not be a required deliverable. If other documentation is utilized to meet these requirements, the delivery dates shall remain the same.

### 1.1 Scope

The requirements stated in this attachment apply to all work accomplished by the GDS developer and their subcontractors.

### 1.2 Applicable Documents (Section 3.0)

To the extent referenced herein, applicable portions of the documents listed in Section 3.0 form a part of this document (i.e., the GLAST GDS MAR). The latest version of

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each document, at the time of the issue of this document, is applicable. In the event of a conflict between the documents listed in Section 3.0 and this requirements specification, the contents of this specification shall be considered the superseding requirements. In the event of a conflict between this Mission Assurance Requirements document and the Mission Operations Center (MOC) Statement of Work (SOW), the SOW shall take precedence. In the event of any other unresolved conflict, the contracting officer shall be notified, and the order of precedence will be as directed by the contracting officer.

### **1.3 Acronyms (Section 4.0)**

Section 4.0 defines the acronyms used in this document.

### **1.4 Overall System Safety and Mission Assurance (S&MA) Requirements**

The developer is required to plan and implement an organized S&MA Program that encompasses all ground system software and hardware critical for mission success.

Managers of the developer assurance activities shall have direct access to developer management independent of project management, with the functional freedom and authority to interact with all other elements of the project. Issues requiring project management attention shall be addressed with the developer(s) through the Project Manager(s) and/or Contracting Officer Technical Representative(s) (COTR).

### **1.5 Surveillance of Developer**

The work activities, operations, and documentation performed by the developer and/or his suppliers are subject to evaluation, review, audit, and inspection by Government-designated representatives from GSFC, the Government Inspection Agency (GIA), or an independent assurance contractor (IAC). The developer and/or suppliers shall grant access for NASA and/or NASA representatives to conduct an assessment/survey upon notice. Resources shall be provided to assist with the assessment/survey with minimal disruption to work activities. The developer, upon request, shall provide government assurance representatives with the documents, records, and equipment required to perform their S&MA activities. The developer shall also provide the government assurance representative(s) with an acceptable work area within developer facilities.

### **1.6 S&MA-Related Deliverables (Appendix A)**

Appendix A of this document contains Data Item Descriptions (DID's) that describe S&MA-related data deliverable to the Government; i.e., the NASA GSFC Project Office. The "DID letters" cited throughout this document refer to the numbers listed on the DID's contained in Appendix A. Deliverables may be received/reviewed by GSFC personnel at either GSFC or at the developer's facility as specified in the respective DID.

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The following definitions apply with respect to S&MA deliverables:

**Deliver for Approval:** Documents in this category require written GSFC approval prior to use. Requirements for resubmission shall be as specified in the letter(s) of disapproval.

**Deliver for Information/Review:** Documents in this category require receipt by GSFC for the purpose of determining current program status, progress, and future planning requirements. When Government evaluations reveal inadequacies, the developer will be directed to correct the documents.

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## 2.0 Ground Data System Assurance Requirements

GDS components may include but are not limited to GDS software, firmware and hardware, ground support elements (simulators, etc), Commercial Off The Shelf (COTS), databases, key parameter and test checkout software, and any software developed under the project that is related to flight mission operations. These components may be developed in-house entirely by the developer, provided by a sub-developer/subcontractor to the developer, purchased by the government, purchased by the developer, or furnished by other parties including the government.

### 2.1 *Quality Management System*

The developer shall have a Quality Management System (QMS) that is compliant with American National Standards Institute (ANSI)/American Society for Quality (ASQ) Q9001 or equivalent. In all cases the development effort shall provide evidence (quality records for GSFC review) as insight to the quality of the developing software, hardware and other GDS components as evidence of application of QMS processes, and as status of assurance problems, safety issues and organizational/personnel changes. Quality records shall include any corrective actions, relating to GDS development, recommended by QMS audits. The developer will allow NASA audits, when deemed necessary by the Project Manager, to assure compliance of the developer's QMS with ANSI/ASQ Q9001 and to assure that the QMS is applied to the contracted activities. If one exists, the developers Quality Manual shall be delivered or made available to the Government in accordance with **DID B**.

The developer shall maintain/possess a QA organization/entity that is assigned the responsibility to monitor the development process, and the associated components/products. QA shall interface with all relevant disciplines participating in the lifecycle activities including engineering, configuration management and testing. The QA group is empowered to alert project management to effect changes to the program when quality goals are not being met.

The developer shall follow a written QA plan for measuring and monitoring the performance of the program's defined management and development processes. The developer shall verify adherence to the defined development and management processes. The developer shall perform audits on designated work products to verify compliance with quality goals, and adherence to the applicable standards and requirements. The developer shall identify training to be performed. A Quality Assurance Plan shall be delivered to the Government in accordance with **DID C**. If the developer delivers other documentation that meets the requirements of the Quality Assurance Plan, then the Quality Assurance Plan will not be required to be a deliverable.

The developer shall plan and document software development processes and procedures, software tools, resources, and deliverables throughout the lifecycle. A Software Development Plan (SDP) shall be delivered to the Government in accordance with **DID D**. If the developer delivers other documentation that meets the requirements of the SDP, then the SDP will not be required to be a deliverable.

## **2.2 Requirements**

The developer shall identify, document and maintain GDS requirements that will serve as the basis of the development, implementation, operation and maintenance of the GDS and its components. These requirements shall include but are not limited to functional, performance, reliability, maintainability, safety and test/verification requirements.

The developer shall work with GSFC and/or other entities as necessary to resolve any problems/issues associated with the GDS requirements.

The developer shall baseline the GDS requirements early in the development effort, specifically in conjunction with a formal requirement review. The developer shall maintain the GDS requirements under configuration control throughout the lifecycle. All changes to the GDS requirements, including those generated both internally and externally, shall be managed by the developer's Configuration Control Board (CCB) process and reviewed/approved as applicable by GSFC.

GDS requirements shall be delivered to the Government in accordance with **DID E**.

## **2.3 Reviews**

The developer shall implement a program of engineering reviews (peer reviews) throughout the development lifecycle to identify and resolve concerns prior to formal, system level reviews.

The developer shall conduct a program of planned, scheduled, and documented system level reviews. GDS review packages shall be delivered to the Government in accordance with **DID F**.

## **2.4 Assurance Activities**

The developer shall perform various assurance-related activities throughout the development lifecycle to ensure that the GDS and its components meet GDS requirements. The developer shall initiate these activities as early in the development lifecycle as possible, specifically in the concept phase, and continue these activities into the operations and maintenance phase where applicable. Some of these assurance-

related activities are applicable to all phases of the lifecycle and the developer shall conduct these activities throughout the entire lifecycle.

## **2.5 Requirements Phase**

Specific assurance-related activities that the developer shall perform during the requirements phase include but are not limited to the following (Note: Some of these activities may be performed prior to this phase or subsequent to this phase where applicable):

- a. Analyze and refine the requirements to assure they are consistent, clear, valid, feasible, compatible, complete, testable and do not include inappropriate level of design information
- b. Ensure requirements are generated, analyzed, refined, decomposed and allocated to appropriate GDS components through the use of a systems analysis and allocation process. This process shall be used to verify requirements are correct and complete at each level prior to further allocation and decomposition, and to verify them for feasibility and top-level design concept prior to further allocation.
- c. Establish functional, performance, safety, reliability, maintainability and test/verification requirements for each incremental system (delivery/build) as applicable. This process should assure all requirements are allocated to planned increments prior to the design and development of the increment.
- d. Manage allocation of new and additional requirements between hardware, software and other components by a change review and control process; and manage the reallocation of existing requirements between hardware, software and other components by a change review and control process
- e. Use a defined process to generate, review and allocate interface requirements
- f. Maintain a process to provide, ensure and maintain two-way requirements traceability from system specifications to hardware, software and other components that serve as configuration items. This requirement traceability shall be established and documented as early in the lifecycle as possible.
- g. Generate, document and maintain a requirements verification matrix
- h. Conduct a requirement review and at the end of each phase of the development process ensure requirements are complete and testable

## **2.6 Design Phase**

Specific assurance-related activities that the developer shall perform during the design phase include but are not limited to the following (Note: Some of these activities may be performed prior to this phase as applicable.):

- a. Maintain a process to define, maintain, and document interfaces (both internal and external) within the architecture
- b. Allocate and maintain traceability between the GDS architecture/components and the GDS requirements

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- c. Conduct design walkthroughs and reviews
- d. Place the design under configuration control

## **2.7 Implementation Phase**

Specific assurance-related activities that the developer shall perform during the implementation phase include but are not limited to the following (Note: Some of these activities may be performed prior to this phase as applicable):

- a. Define, schedule, and document the components of each build, delivery and/or release
- b. Conduct peer reviews/walkthroughs for code
- c. Conduct unit testing
- d. Conduct reviews and appropriate tests at the end of this phase of the development process to ensure that the requirements have been correctly implemented into design, code, documentation and data
- e. Allocate and maintain traceability between the GDS architecture/components and the GDS requirements

## **2.8 Testing Phase**

Specific assurance-related activities that the developer shall perform during the test phase include but are not limited to the following (Note: Some of these activities may be performed prior to this phase as applicable):

- a. Plan for and document test related activities early in the development stages of the project in a test plan(s). The plan shall be maintained under configuration control and updated as requirements are changed. All test plans shall be made subject to GSFC review and approval as applicable. The developer's test plans shall include but is not limited to the following:
  - 1. Description of the tests to be performed including the different levels of testing (from units to Computer Software Configuration Items (CSCIs) to subsystem to system-level test), expected test results, personnel responsible for testing, any required support from other organizations and data required for the test(s)
  - 2. GDS components to be tested
  - 3. Test environment under which the test(s) will be conducted including test facility requirements, special test support tools (i.e., simulators, emulators, etc.) and any special operating conditions required
  - 4. Requirements Verification Matrix (RVM) documenting traceability of requirements to test cases
- b. Generate test procedures that implement the test plans and facilitate the verification and validation of GDS requirements. All test procedures shall be made subject to GSFC review and approval as applicable.

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- c. Maintain a process to ensure that any test tools and test data are qualified prior to use during testing activities
- d. Ensure that test personnel attend and participate as necessary in various reviews throughout the lifecycle, to include but not limited to requirements, architecture and design reviews
- e. Identify and document test readiness criteria for formal testing activities. Test criteria shall be made subject to GSFC review and approval as applicable.
- f. Maintain and update the RVM generated earlier in the lifecycle to include the status (pass, fail, deferred, etc) of each requirement throughout the testing phases and various testing activities
- g. Test reports should document the validation of requirements, specific tests completed, conformance of the test results to the expected results, the number, type and criticality of any identified discrepancies/nonconformances, identification of the hardware, software and other GDS components tested including version number, etc.
- h. Document all defects/nonconformances encountered during the testing activities. These defects/nonconformances shall be assessed for criticality, severity, impact, etc to determine appropriate action and resolution. The developer shall track and report on the status of all defects/nonconformances.
- i. Identify all nonconformances that impact the developer's ability to meet GDS requirements and document these items in a waiver, which must be reviewed/approved by GSFC as applicable
- j. Ensure and maintain configuration control of the test environment including hardware, software, simulators, test data, databases and other components throughout the test program
- k. Assess all changes made to the system architecture and its components to determine the necessity for regression testing. The developer shall conduct regression testing based upon assessed and approved/implemented changes as appropriate.
- l. Conduct contingency and off-nominal condition testing
- m. Conduct pre-test briefings and generate briefing messages where appropriate to facilitate the coordination of various test related activities. Briefing message contents may include but are not limited to:
  - 1. Test Case/Procedure Name/Number
  - 2. Purpose of the Test
  - 3. Testing Dates/Times
  - 4. Test Participants and required resources (scheduling of lab and station support, data sources (e.g. s/c, s/c data tape, engineering test unit or s/c simulator), software, hardware and support system configurations (to include release/version numbers where appropriate)
  - 5. GDS requirements to be verified
  - 6. Contact list to include names and numbers of test participants

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- n. Conduct post-test debriefings. During these debriefs, the developer shall summarize test results, disposition the test (pass/fail, etc), deviations from test procedures, requirements verified and discrepancy reports generated, etc.
- o. Conduct mission simulations to validate nominal and contingency mission operating procedures and to provide for operator familiarization training. In order to provide ample time for checkout of operational configurations, it is considered essential that users participate in mission simulations. Ground operation procedures shall be delivered to the Government in accordance with **DID G**.

A System Performance Verification Plan, Performance Verification Procedures, and Verification Reports shall be delivered to the Government in accordance with **DID I**, **DID J**, and **DID K** respectively.

## **2.9 Delivery Phase**

Specific assurance-related activities that the developer shall perform during the delivery phase include but are not limited to the following (Note: Some of these activities may be performed prior to this phase as applicable):

1. System delivery letter:
  - (a) Description of hardware and software delivery contents
  - (b) Build instructions, including the source code, databases and all files required to complete a successful software build
  - (c) Special operating instructions
  - (d) List of resolved anomaly reports and change requests
  - (e) List of unresolved anomaly reports and change requests
  - (f) Copy of resolved anomaly reports and change requests
  - (g) Copy of unresolved anomaly reports and change requests
  - (h) Matrix of requirements addressed by this release, including waivers for those requirements not met as appropriate
  - (i) List of changes to documentation associated with this release
  - (j) Verification success criteria
  - (k) Known problems and workarounds
2. Software delivery media
3. Accompanying documentation

Data delivery packages shall be delivered to the Government in accordance with **DID L**.

## **2.10 COTS, Existing and Purchased Software**

If the developer will be provided software, or will use existing or purchased software and/or COTS products, the developer is responsible for these components meeting all functional, performance and interface requirements. Any significant modification to these components shall be subject to all of the provisions of the developer's QMS and

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the provisions of this document. Significant modification will be defined by the project and its CCB procedures and will be subject to GSFC review.

## **2.11 COTS Management**

The developer shall identify and maintain traceability of GDS requirements satisfied by COTS products/components and shall document the rationale/justification for the selection of all COTS components contained within the GDS. The developer shall ensure that the CM program covers all COTS/components.

The developer shall demonstrate and document the fulfillment of GDS requirements by COTS products/components via the RVM.

## **2.12 Databases**

The developer shall maintain a process and procedures for database development as appropriate. The process shall include activities such as internal reviews, walkthroughs, statusing, test, and discrepancy resolution.

The developer shall utilize a process for the verification and validation of the database system.

The developer shall ensure that system/software releases and database releases are configured with one another.

The developer shall implement CM on the database system to ensure that the database release version is defined and documented, controlled and that the integrity of the data contained within is controlled.

The developer shall ensure that appropriate security measures are implemented on the database system and on the data contained within the database system.

## **2.13 Security Assurance**

The developer shall conduct a security program to identify and mitigate security risks associated with the GDS and its components. All security risks shall be assessed/analyzed for impact and likelihood of occurrence. The security program shall ensure that security requirements are established, documented and implemented during all phases of the software lifecycle. Security tasks and activities shall include the addressing of security concerns during reviews, analyses, inspections, testing and audits.

The developer shall identify and characterize system security vulnerabilities to include analyzing GDS assets/components, defining specific vulnerabilities, and providing an assessment of the overall system vulnerability. The developer shall identify and report

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upon all breaches of, attempted breaches of, or mistakes that could potentially lead to a breach of security.

The developer shall ensure that solutions are verified and validated with respect to security.

The developer shall be compliant with all NASA security related policies, procedures, standards and guidelines.

## ***2.14 Electromagnetic Compatibility Control***

The developer shall demonstrate that GDS equipment is not affected by electromagnetic compatibility problems nor does it pose a threat to other equipment.

## ***2.15 Reliability, Availability, and Maintainability***

Reliability, availability and maintainability assurance requirements for the GDS and associated components shall include the following:

- a. Starting in the conceptual design stage the developer shall clearly define, based upon GLAST mission success criteria and reliability requirements, levels of performance. The developer shall establish and implement specific design criteria needed to mitigate unacceptable levels of performance. Design criteria shall be accessible for GSFC review.
- b. Based on the definition of acceptable levels of performance, the developer shall define the following minimum acceptable maintainability parameters:
  1. Diagnostic time to detect and fault isolate to the defective Line Replacement Unit (LRU)
  2. Time required to remove and replace the defective LRU
  3. Time required to complete checkout and restore operational status
- c. The developer shall assure that equipment and components obtained from COTS vendors meet allocated requirements and if not, such deficiencies shall be reported to GSFC.
- d. The developer shall develop and implement specific design criteria to facilitate maintenance or repair actions. In establishing maintainability design criteria that meets the specification, the contractor shall use data obtained from similar system installations. Design criteria shall include design for modularity, optimum accessibility, accurate fault diagnostics, standardization, and commonality. Design criteria shall be accessible for GSFC review.

## ***2.16 Risk Management***

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The developer shall implement a Continuous Risk Management System (CRMS) that provides for the identification, analysis, tracking, communication, resolution, mitigation and retirement of mission risks. Risk management applies to all software and hardware products, components and processes. The developer shall:

- a. Search for, locate, identify and document reliability and quality risks before they become problems.
- b. Evaluate, classify and prioritize all identified reliability and quality risks.
- c. Develop and implement risk mitigation strategies, actions and tasks and assign appropriate resources.
- d. Track risks being mitigated; capture risk attributes and mitigation information by collecting data; establish performance metrics; and examine trends, deviations and anomalies.
- e. Control risks by performing risk close-out, re-planning, contingency planning, or continued tracking and execution of the current plan.
- f. Communicate and document (via the risk recording, reporting, and monitoring system) risk information to ensure it is conveyed between all levels of the project.
- g. Report on outstanding risk items at all management and design reviews. The GSFC Project Office, the GSFC Systems Review Office (SRO) (for design reviews only), and the developer will agree on what level of detail is appropriate for each review.

The developer shall develop a Risk Management Plan, see **DID N**. The plan shall include risks associated with hardware (technical challenges, new technology qualification, etc), software, COTS, system safety, performance and programmatic risks (cost and schedule). The plan shall identify which tools and techniques will be used to manage the risks. The risk areas that are identified shall be addressed at the peer reviews and at independent and Code 300 reviews. All identified reliability and quality risks shall be documented and reported in accordance with the Project's Risk Management Plan. Risk status shall be available to the Project for review. The status of risks shall also be provided in technical review reports. Although not all risks will be fully mitigated, all risks shall be addressed with mitigation and acceptance strategies agreed upon at appropriate mission reviews. If the developer delivers other documentation that meets the requirements of the Risk Management Plan, then the Risk Management Plan will not be required to be a deliverable.

## **2.17 Software Configuration Management**

The developer shall maintain a Software Configuration Management (SCM) system that provides control of changes to software products, beginning in the requirements phase and continuing until government acceptance.

The developer shall ensure the configuration management system addresses baseline control, configuration identification, configuration control, configuration status accounting and configuration authentication. The developer shall describe the SCM system in a SCM Plan, see **DID O**. If the developer delivers other documentation that

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meets the requirements of the SCM Plan, then the SCM Plan will not be required to be a deliverable.

## **2.18 System Safety**

The developer shall initiate a safety program to identify and mitigate safety critical GDS components. If any GDS component(s) are identified as safety critical, the developer shall conduct a safety program on those components in compliance with NPG 8715.3, "NASA Safety Manual". For GDS components that are software and deemed as safety critical, the safety program shall be implemented in accordance with NASA-STD-8719.13A "NASA Software Safety Standard". The developer shall establish and identify procedures and instructions, which will be used to execute all system safety analyses.

## **2.19 Problem Reporting and Corrective Action**

The developer shall implement a process for Problem Reporting and Corrective Action that addresses reporting, analyzing and correcting nonconformances throughout the development lifecycle. The developer's QMS shall provide for a corrective action process that tracks every nonconformance to its final disposition.

The Problem Reporting system and Corrective Action process shall include:

- a. Nonconformance detection and reporting procedures.
- b. Nonconformance tracking and management procedures.
- c. Nonconformance impact assessment and corrective action procedures.
- d. Interfaces to the Configuration Management process.

## **2.20 Independent Verification and Validation**

This section is applicable only if a NASA Independent Verification and Validation (IV&V) program is required for the GDS.

The developer shall provide all information required for the IV&V effort to NASA IV&V personnel. This includes, but is not limited to, access to all software reviews and reports, developer plans and procedures, software code, software design documentation, and software problem reporting data. Wherever possible, the developer shall permit electronic access to the required information or furnish soft copies of requested information to NASA IV&V personnel.

The developer shall review and assess all NASA IV&V findings and recommendations. The developer shall forward their assessment of these findings and recommendations to NASA IV&V personnel accordingly. A developer Point of Contact shall be assigned and available to NASA IV&V personnel for questions, clarification, and status meetings, as needed.

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### 3.0 Referenced Documents

ANSI/ISO/ASQ Q9001: 2000	American National Standard Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing
CR 5320-9	Payload and Experiment Failure Mode Effects Analysis and Critical Items List Ground Rules
EWR 127-1	Eastern and Western Range Safety Requirements
FAP P-302.720	Performing a Failure Mode and Effects Analysis
ISO 10013	Guidelines For Developing Quality Manuals
KHB 1700.7C	Space Transportation System Payload Ground Safety Handbook
KHB 1710.2C	Kennedy Space Center Safety Practices Handbook
MIL-STD-1629A	Procedures for Performing a Failure Mode Effects and Criticality Analysis
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
NASA-STD 8719.13A	NASA Software Safety Standard
NPG 2810.1	NASA Security of Information Technology
NPG 8715.3	NASA Safety Manual

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## 4.0 Acronyms

ANSI	American National Standards Institute
ASQ	American Society for Quality
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CDRL	Contract Delivery Requirement List
CIL	Critical Items List
CM	Configuration Management
COTR	(GSFC GLAST) Contracting Officer's Technical Representative
COTS	Commercial Off The Shelf
CRMS	Continuous Risk Management System
CSCI	Computer Software Configuration Items
DBMS	Database Management System
DID	Data Item Description
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FCA	Functional Control Audit
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes and Effects and Criticality Analysis
GBM	GLAST Burst Monitor
GDS	Ground Data System
GFE	Government Furnished Equipment
GIA	Government Inspection Agency
GLAST	Gamma-ray Large Area Space Telescope
GSFC	Goddard Space Flight Center
IAC	Independent Assurance Contractor
ICD	Interface Control Document
IOC	In-Orbit Checkout
IV&V	Independent Verification and Validation
L&EO	Launch and Early Orbit
LRU	Line Replacement Unit
LAT	Large Area Telescope
MAR	Mission Assurance Requirements (Document)
MOC	Mission Operations Center
ORR	Operation Readiness Review
PAIP	Performance Assurance Implementation Plan
PCA	Physical Control Audit
PDR	Preliminary Design Review
PSR	Pre-Shipment Review
QA	Quality Assurance
QMS	Quality Management System
RVM	Requirements Verification Matrix
SAM	(GSFC GLAST) Systems Assurance Manager
S&MA	System Safety and Mission Assurance
SCM	Software Configuration Management
SDP	Software Development Plan
SOW	Statement of Work

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SRO        Systems Review Office  
SRR        System Requirements Review

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## APPENDIX A

# SAFETY AND MISSION ASSURANCE RELATED GROUND DATA SYSTEM DELIVERABLES

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**Table A- 1: Summary of Safety and Mission Assurance Related Deliverables**

<b>DID Ltr.</b>	<b>Description</b>	<b>Due Date, Maturity</b>	<b>AI</b>
A	Performance Assurance Implementation Plan	30 Days Prior SRR As Generated, Updates	A
B	Quality Manual	30 Days After Contract Award As Generated, Updates	I
C	Quality Assurance Plan	30 Days Prior SRR, Final As Generated, Updates	A
D	Software Development Plan	90 Days After SRR, Final As Generated, Updates	A
E	GDS Requirements	30 Days Prior SRR, Initial 30 Days Prior PDR, Final As Generated, Updates	I A A
F	GDS Review Packages	30 Days Prior to the Appropriate Review	I
G	Ground Operations Procedures	90 Days Prior to ORR, Preliminary ORR, Final	I
H	System Performance Verification Plan	30 Days Prior PDR, Initial 30 Days Prior CDR, Final As Generated, Updates	I A A
I	Performance Verification Procedure	30 Days Prior to Test, Final	I
J	Verification Reports	Verification Reports: 72 Hours After Test, Initial Verification Reports: 30 Days After Verification Activity, Final	I
K	Data Delivery Packages	Provided with hardware and software deliveries, Final	I
L	Risk Management Plan	30 Days Prior SRR, Final As Generated, Updates	A

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M	Software Configuration Management Plan	30 Days Prior PDR, Initial 30 Days Prior CDR, Final As Generated, Updates	A
<b><u>Table Acronyms/Abbreviations:</u></b>  A      For Approval A/I    For Approval/For Information CDR    Critical Design Review DID    Data Item Description I       For Information PDR    Preliminary Design Review PSR    Pre Ship Review SRR    System Requirements Review			

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## DID A: Performance Assurance Implementation Plan

<b>Title:</b> Performance Assurance Implementation Plan	<b>DID No.:</b> A
<b>Reference:</b> Ground Data System MAR, Section 1.1	
<b>Purpose:</b> Documents the developer's plan on how the developer will implement the requirements listed in the GDS MAR	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> Provide within 30 days prior to the SRR for GSFC approval. Updates are due to GSFC as generated.  The PAIP shall include: <ul style="list-style-type: none"> <li>a. An overview of the developer's plan for accomplishing the assurance activities required by the GDS MAR</li> <li>b. Specific and detailed description of how the performance assurance requirements are to be accomplished. Referenced documents that provide the required details shall be submitted with the PAIP.</li> <li>c. The rationale for any planned noncompliance to the GDS MAR including the details of the developer's alternate approach, if any, to meet the specific GDS MAR requirement</li> </ul>	

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DID B: Quality Manual

<b>Title:</b> Quality Manual	DID No.: B
<b>Reference:</b> Ground Data System MAR, Sections 2.1	
<b>Purpose:</b> Documents the developer's quality management system	
<b>Related Documents:</b> ANSI/ISO/ASQ Q9001	
<p><b>Preparation Information:</b></p> <p>Provide with proposal for GSFC review. Provide Quality Manual updates to GSFC Project Office for review prior to implementation or provide with proposal for information along with evidence of third party certification/registration of the developer's quality management system by an accredited registrar.</p> <p>Prepare a Quality Manual addressing all applicable requirements of ANSI/ISO/ASQ Q9001. Refer to ISO 10013 for further guidelines on preparation of a quality manual.</p> <p>The Quality Manual shall contain:</p> <ol style="list-style-type: none"> <li>The title, approval page, scope and the field of application</li> <li>Table of contents</li> <li>Introductory pages about the organization concerned and the manual itself</li> <li>The quality policy and objectives of the organization</li> <li>The description of the organization, responsibilities and authorities, including the organization responsible for the reliability, safety and test requirements implementation</li> <li>A description of the elements of the quality system, developer policy regarding each element and developer implementation procedure for each Q9001 clause or reference(s) to approved quality system procedures. System level procedures shall address the implementation of all requirements cited in this document.</li> <li>A definitions section, if appropriate</li> <li>An appendix for supportive data, if appropriate</li> </ol> <p>Quality Manual distribution and changes shall be implemented by a controlled process. The Quality Manual shall be maintained/updated by the developer throughout the life of the contract.</p>	

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## DID C: Quality Assurance Plan

<b>Title:</b> Quality Assurance Plan	<b>DID No.:</b> C
<b>Reference:</b> Ground Data System MAR, Section 2.2	
<b>Purpose:</b> The purpose of the Quality Assurance Plan is to specify the conduct of quality assurance, quality engineering assurance, safety assurance, security and privacy assurance, testing, verification and validation, and certification during the acquisition or development of software.	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> <p>The final quality assurance plan is due to GSFC 30 days prior to SRR for approval. Updates are due to GSFC as generated.</p> <p>Topics to be included in the Quality Assurance Plan are:</p> <ul style="list-style-type: none"> <li>a. Quality Assurance</li> <li>b. Verification and Validation</li> <li>c. Quality Engineering Assurance</li> <li>d. Safety Assurance</li> <li>e. Security and Privacy Assurance</li> <li>f. Certification</li> </ul>	

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DID D: Software Development Plan

<b>Title:</b> Software Development Plan	<b>DID No.:</b> D
<b>Reference:</b> Ground Data System MAR, Section 2.2	
<b>Purpose:</b> This data item provides an outline for the Software Development Plan	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> <p>The final Software Development Plan is due to GSFC 90 days following the SRR for approval. Updates are due to GSFC as generated.</p> <p>Topics to be included in the Software Development Plan are:</p> <ol style="list-style-type: none"> <li>Purpose and Description</li> <li>Resources, Budgets, Schedules, and Organization</li> <li>Acquisition Activities</li> <li>Development Activities</li> <li>Sustaining Engineering and Operations Activities</li> <li>Quality Assurance</li> <li>Risk Management</li> <li>Configuration Management</li> <li>Delivery and Operational Transition</li> </ol>	

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DID E: GDS Requirements

<b><u>Title:</u></b> GDS Requirements	<b>DID No.:</b> E
<b><u>Reference:</u></b> Ground Data System MAR, Section 2.2	
<b><u>Purpose:</u></b>  The GDS Requirements specifies in detail all of the functional, performance, testing, security and safety requirements associated with the Ground Data System.	
<b><u>Related Documents:</u></b> None	
<b><u>Preparation Information:</u></b> Preliminary GDS Requirements are due to GSFC 30 days prior to SRR for review. Final GDS Requirements are due to GSFC 30 days prior to PDR for approval. Updates are due to GSFC as generated.  In addition to the GDS Requirements, a traceability matrix will be provided that maps each requirement to the parent requirement from which it was derived. Additionally, the test method used to verify each requirement will be identified.	

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## DID F: GDS Review Packages

<b>Title:</b> GDS Review Packages	DID No.: F
<b>Reference:</b> Ground Data System MAR, Section 2.3	
<b>Purpose:</b> Reviews shall be held to provide a greater understanding and in-depth look at the GDS and the process in use to design, implement, test and verify.	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> Review packages are due to GSFC 30 days prior to the review for review.  The following review packages will contain at a minimum:  System Requirements Review: <ul style="list-style-type: none"> <li>a. Review of requirements</li> <li>b. Risk and mitigation strategies for the requirements</li> <li>c. Requirement management approach, tools</li> <li>d. Status of requirements related deliverables</li> <li>e. Test philosophy, test tools</li> </ul> Preliminary Design Review: <ul style="list-style-type: none"> <li>a. Organization/Work Breakdown Structure/Project relationship</li> <li>b. Deliverables and schedules</li> <li>c. Configuration Management and Product Assurance approach, tools</li> <li>d. Requirements and interface management</li> <li>e. Development tools and approach</li> <li>f. Risk Management approach</li> <li>g. Risks identified; mitigation</li> <li>h. Test approach and test planning status</li> </ul> Critical Design Review: <ul style="list-style-type: none"> <li>a. Deliverables and schedules, time budgets – update</li> <li>b. Product Assurance methods and findings – update</li> <li>c. On a component, task, class, thread, or other functional block boundary: cover function/requirement, inputs/outputs, timing/sizing estimates, throughput requirements, command inputs, telemetry and status outputs.</li> <li>d. For test software and simulations identified to meet requirements, review the status and technical progress on these elements.</li> <li>e. Risks, issues and mitigation</li> </ul> Mission Operations Review: <ul style="list-style-type: none"> <li>a. Overall schedule and status</li> <li>b. Closure of previous reviews</li> <li>c. Mission operations readiness approach</li> </ul>	

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- d. Software maintenance approach
- e. Mission planning and scheduling
- f. Real-time operations including: health and safety monitoring, safe mode operation
- g. Science operations planning, data processing and analysis
- a. Risks, issues and mitigation

Operations Readiness Review:

- a. Closure of actions from the Mission Operations Review
- b. New requirements and changes in plans
- c. Test result summaries including the Project's assessment of the criticality of open problems
- d. Work remaining including tests, simulations, and closure of problems
- e. Personnel location for Launch & Early Orbit (L&EO) and In-Orbit Checkout (IOC) including Project office, operations, and spacecraft subsystem expert personnel.
- f. Contingency procedures, development and verification/validation status

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## DID G: Ground Operations Procedures

<b>Title:</b> Ground Operations Procedures	DID No.: G
<b>Reference:</b> Ground Data System MAR, Section 2.8	
<b>Purpose:</b> All ground operations procedures to be used at GSFC facilities, other integration facilities, or the launch site shall be submitted to the GSFC Project Safety Manager for review and concurrence. Launch site ground operations procedures shall be submitted to applicable Range Safety 45 days prior to use.	
<b>Related Documents:</b> EWR-127, KHB 1700.7C, KHB 1710.2D, and/or launch vehicle contractor	
<b>Preparation Information:</b> Preliminary ground operation procedures are due to GSFC 90 days prior to the ORR. Final ground operation procedures will be submitted at the ORR.  All hazardous operations as well as the procedures to control them shall be identified and highlighted. All launch site procedures shall comply with the applicable launch site safety regulation.	

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## DID I: System Performance Verification Plan

<b>Title:</b> System Performance Verification Plan	<b>DID No.:</b> H
<b>Reference:</b> Ground Data System MAR, Section 2.8	
<b>Purpose:</b> Provides the overall approach for accomplishing the verification program. Defines the specific tests, analyses, calibrations, alignments, etc. that will demonstrate that the hardware complies with the mission requirements	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> <p>A preliminary system performance verification plan is due 30 days prior to the PDR for GSFC review. The final system performance verification plan is due to GSFC 30 days prior to the CDR for GSFC approval. Updates are due to GSFC as generated.</p> <p>Describes the approach (test, analysis, etc.) that will be utilized to verify that the hardware/software complies with mission requirements. If verification relies on tests or analyses at other level of assemblies, describe the relationships.</p> <p>A section of the plan shall be a "System Performance Verification Matrix" summarizing the flow-down of system specification requirements that stipulates how each requirement will be verified, and summarizes compliance/non-compliance with requirements. It shall show each specification requirement, the reference source (to the specific paragraph or line item), the method of compliance, applicable procedure references, report reference numbers, etc. The System Performance Verification Matrix may be made a separate document.</p>	

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## DID J: Performance Verification Procedure

<b>Title:</b> Performance Verification Procedure	<b>DID No.:</b> I
<b>Reference:</b> Ground Data System MAR, Section 2.8	
<b>Purpose:</b> Describes how each test activity defined in the Verification Plan will be implemented	
<b>Related Documents:</b> None	
<b>Preparation Information:</b> <p>The performance verification procedure is due to GSFC 30 days prior to testing for GSFC approval.</p> <p>Describe the configuration of the tested item and the step-by-step functional test activity conducted at the unit/component, subsystem/instrument, and payload levels. Give details such as instrumentation monitoring, facility control sequences, test article functions, test parameters, quality control checkpoints, pass/fail criteria, data collection and reporting requirements. Address safety control provisions. A methodology shall be provided for controlling, documenting and approving all activities not part of an approved procedure.</p>	

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## DID K: Verification Reports

<b>Title:</b> Verification Reports	<b>DID No.:</b> J
<b>Reference:</b> Ground Data System MAR, Section 2.8	
<b>Purpose:</b> Summarize compliance with system specification requirements and/or provide a summary of testing and analysis results, including conformance, nonconformance, and trend data	
<b>Related Documents</b> None	
<b>Preparation Information:</b> <p>Preliminary verification reports are due to GSFC 72 hours after testing. The final verification report is due to GSFC 30 days after the verification activity.</p> <p>Verification Report: Provide after each unit/component, subsystem/instrument, and payload verification activity. For each analysis activity the report shall describe the degree to which the objectives were accomplished, how well the mathematical model was validated by the test data, and other significant results.</p>	

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## DID L: Data Delivery Packages

<b><u>Title:</u></b> Data Delivery Packages	<b>DID No.:</b> K
<b><u>Reference:</u></b> Ground Data System MAR, Section 2.9	
<b><u>Purpose:</u></b> Describe the documentation that accompanies hardware and software deliveries	
<b><u>Related Documents</u></b> None	
<b><u>Preparation Information:</u></b> Each hardware and software delivery must have a Data Delivery Package that contains the items listed in the Ground Data System MAR, Section 2.9, as appropriate.	

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DID N: Risk Management Plan

<b>Title:</b> Risk Management Plan	DID No.: L
<b>Reference:</b> Ground Data System MAR, Section 2.16	
<b>Purpose:</b> The purpose of the Risk Management Plan is to define the process by which the developer identifies, evaluates and minimizes the risks associated with GDS development..	
<b>Related Documents</b> None	
<b>Preparation Information:</b> The final Risk Management plan is due to GSFC 30 days prior to the SRR for GSFC review. Updates are due to GSFC as generated.  Topics to be included in the Risk Management Plan are: <ul style="list-style-type: none"> <li>a. Risk Assessment and Evaluation Process</li> <li>b. Technical Risks.</li> <li>c. Safety Risks</li> <li>d. Security Risks</li> <li>e. Resource Risks</li> <li>f. Schedule Risks</li> <li>g. Cost Risks</li> </ul>	

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DID O: Software Configuration Management Plan

<b>Title:</b> Software Configuration Management Plan	DID No.: M
<b>Reference:</b> Ground Data System MAR, Section 2.17	
<b>Purpose:</b> The purpose of the Software Configuration Management Plan is to define the configuration management process for the software and its associated products.	
<b>Related Documents</b> None	
<b>Preparation Information:</b> <p>The initial Software Configuration Management Plan is due to GSFC 30 days prior to the PDR for GSFC review. The final Software Configuration Management Plan is due to GSFC 30 days prior to the CDR for GSFC approval. Updates are due to GSFC as generated.</p> <p>Topics to be included in the Software Configuration Management Plan are:</p> <ol style="list-style-type: none"> <li>Configuration Management Process Overview</li> <li>Configuration Control Activities</li> <li>Configuration Identification</li> <li>Configuration Change Control</li> <li>Controlled Storage and Release Management</li> <li>Change Control Flow</li> <li>Change Documentation</li> <li>Change Review Process</li> <li>Configuration Status Accounting</li> </ol>	

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